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NATIONAL DAM SAFETY PROGRAM. CUSHMAN LAKE DAM (NJ00447), ATLANT--ETC(U)
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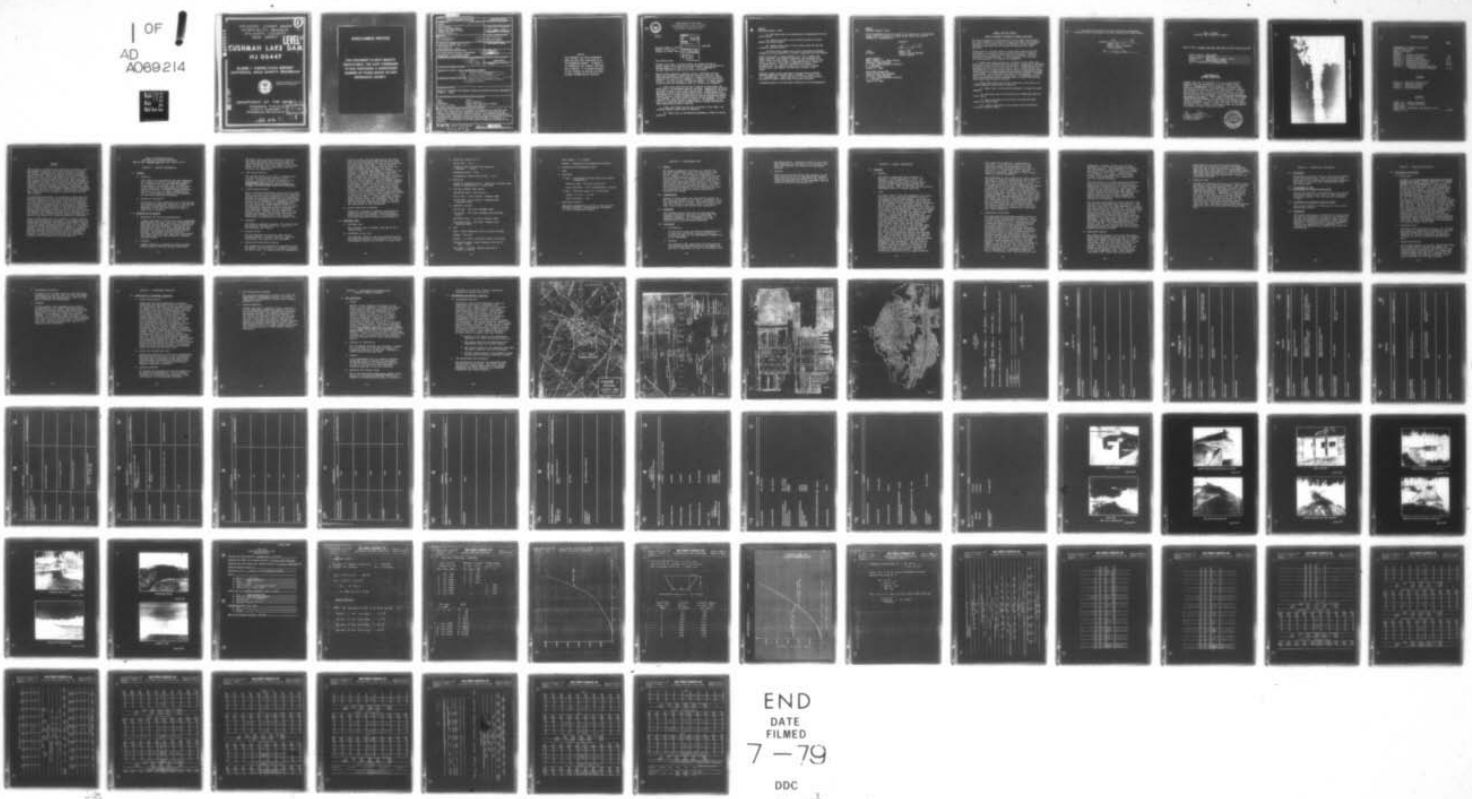

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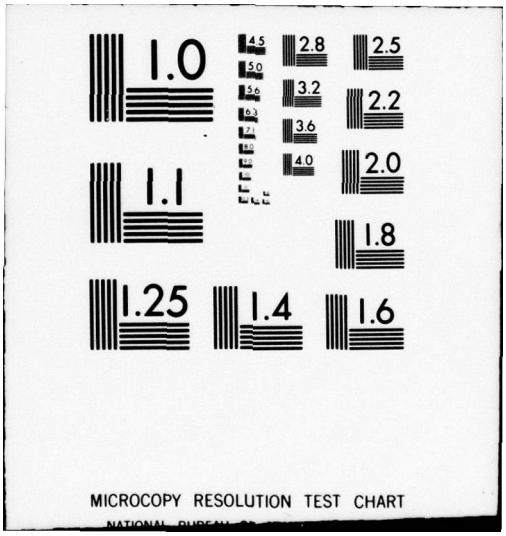
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ATLANTIC COAST BASIN
HOSPITALITY BRANCH
ATLANTIC COUNTY
NEW JERSEY

LEVEL III

CUSHMAN LAKE DAM

NJ 00447

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Approved forpublic release;
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DEPARTMENT OF THE ARMY

Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

April 1979

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18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams	Safety
Joints	Visual Inspection
Embankments	National Dam Inspection Act Report
Structural Analysis	Cushman Lake Dam, N.J.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE – 2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-D

7 MAY 1979

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Cushman Lake Dam in Atlantic County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Cushman Lake Dam, initially listed as a high hazard potential structure but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in poor overall condition. The dam's spillway is considered adequate. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Within thirty days from the date of approval of this report, the entire crest of the embankment should be scarified, recompacted and additional fill added to bring it up to proper line and grade. Additionally, the eroded backslopes should be filled in and protected with a suitable ground cover. Improvements to the present spillway should consist of repairing the exposed concrete surfaces, including sandblasting and applying epoxy-mortar coatings or dry-gunning. The joints should be cleaned out and recaulked. The keeper planks for the stoplogs should be rehabilitated. The embankment at each side of the downstream spillway wingwalls should be further protected with slope paving along the face of each wall.

b. Within three months from the date of approval of this report, the following remedial actions should be completed:

(1) Remove trees on the downstream embankment to lessen the piping potential.

(2) Add riprap stone at the downstream pool immediately below the culvert outlet.

(3) Seal up the cracks in the auxiliary spillways and repair undercut and ravelled edges.

(4) Install timber posts at each abutment across the dam axis to prohibit vehicular traffic.

c. The owners should upgrade their annual preventative maintenance procedures and issue checklists for periodic inspections and record keeping.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman William J. Hughes of the Second District. Under the provisions of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation

of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

James G. Ton

1 Incl
As stated

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Copies furnished:
Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N. J. Dept. of Environmental Protection
P. O. Box CN029
Trenton, NJ 08625

John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
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Trenton, NJ 08625

CUSHMAN LAKE DAM (NJ00447)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 10 January 1979 by Louis Berger and Associates Inc. under contract to the State of New Jersey. The state, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Cushman Lake Dam, initially listed as a high hazard potential structure but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in poor overall condition. The dam's spillway is considered adequate. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Within thirty days from the date of approval of this report, the entire crest of the embankment should be scarified, recompacted and additional fill added to bring it up to proper line and grade. Additionally, the eroded backslopes should be filled in and protected with a suitable ground cover. Improvements to the present spillway should consist of repairing the exposed concrete surfaces, including sandblasting and applying epoxy-mortar coatings or dry-gunning. The joints should be cleaned out and recaulked. The keeper planks for the stoplogs should be rehabilitated. The embankment at each side of the downstream spillway wingwalls should be further protected with slope paving along the face of each wall.

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(4) Install timber posts at each abutment across the dam axis to prohibit vehicular traffic.

c. The owners should upgrade their annual preventative maintenance procedures and issue checklists for periodic inspections and record keeping.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 1 May 1979

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

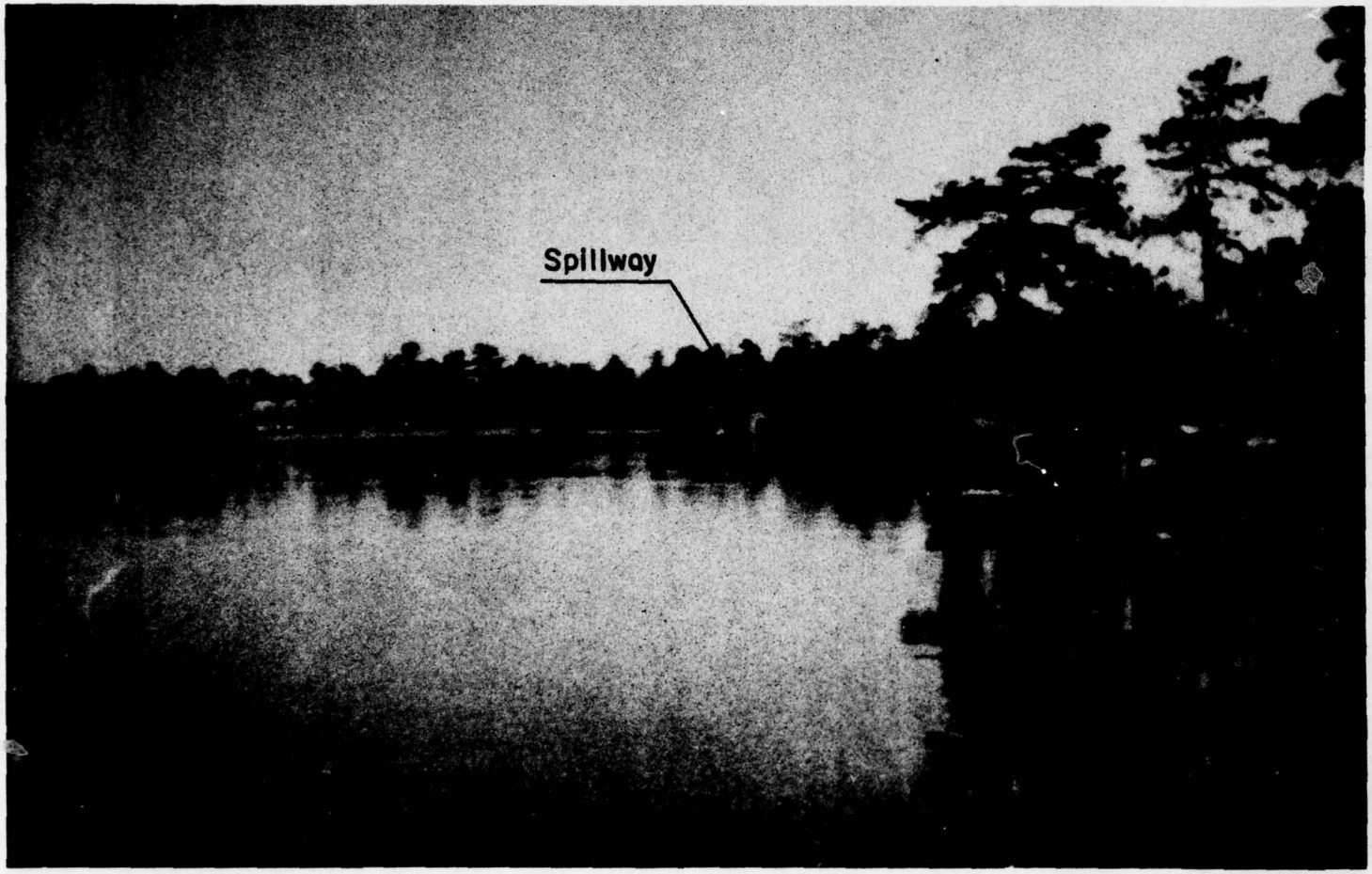
Name of Dam Cushman Lake Dam Fed ID# NJ 00447 and NJ ID# 510

State Located New Jersey
County Located Atlantic
Coordinates Lat. 3935.9 - Long. 7452.4
Stream Hospitality Branch
Date of Inspection 10 January 1979

ASSESSMENT OF GENERAL CONDITIONS

Cushman Lake Dam is assessed to be in a poor overall condition but is recommended to be downgraded from a high to a significant hazard category. The spillway capacity is sufficient to accommodate the design flood and collapse of the dam would not significantly increase the danger of loss of life or property damage. No detrimental findings were uncovered to require further study but portions of the embankment crest should be immediately repaired by the owner. Other remedial actions to be undertaken very soon include: 1) cleaning and patching of the concrete spillway, 2) remove the trees and regrade downstream embankment slopes, 3) seal up cracks in the asphalt spillways, and 4) install timber posts near the abutments to prohibit illegal vehicular traffic.

F. Keith Jolls P.E.
Project Manager



OVERVIEW OF CUSHMAN LAKE DAM

JANUARY 1979

TABLE OF CONTENTS

FIGURES

APPENDIX

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NAME OF DAM CUSHMAN LAKE DAM FED. ID# NJ 00447

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The State, in turn, is under agreement with the U.S. Army Engineer District, Philadelphia, to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Cushman Lake Dam and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Cushman Lake Dam is a 25-year old earth embankment approximately 780 feet long with a reinforced concrete box culvert/spillway structure located 350 feet from the left abutment. The dam was constructed as a part of a large residential subdivision on the site of an existing cranberry bog dam. Two asphalt covered auxiliary spillways 90 and 100 feet wide, were constructed at a later date near each abutment to provide overflow relief.

b. Location

Cushman Lake Dam is located in Collings Lakes, Folsom Borough, Atlantic County, New Jersey.

The dam is built across Hospitality Branch of the Great Egg Harbor River 0.7 mile west of the intersection of State Highway 54 and U.S. Route 322 (Black Horse Pike) which is two miles south of the Route 54 intersection with the Atlantic City Expressway.

c. Size Classification

The maximum height of the dam is approximately 17 feet and the maximum storage is 1940 acre-ft. Therefore the dam is placed in the intermediate size category as defined by Recommended Guidelines for Safety Inspection of Dams (storage greater than 1,000 acre-feet).

d. Hazard Classification

Based on Corps of Engineers criteria and the fact that in the event of a failure the only structures downstream that might be damaged are the Route 54 highway and railroad bridges 0.6 mile downstream, the dam is recommended to be downgraded from high hazard and is classified as significant hazard. The few residences downstream of the dam are situated above the flood elevation and any large instantaneous discharges would be absorbed by the undeveloped Robins Lake bed immediately below the dam. Further, if this lake were ever filled, the hazard classification would not be appreciably worsened as the wide downstream flood plain is undeveloped at the present time.

e. Ownership

According to available records, the lake and dam are owned by Collings Lakes Inc., R.D. #1, Williamstown, New Jersey.

f. Purpose of Dam

The dam impounds a recreation lake and was reconstructed by Collings Lakes Inc. when the surrounding lake community was developed.

g. Design and Construction History

The present dam was constructed (apparently without permit) on the site of an existing cranberry bog dam in 1953. An application was subsequently

filed in August 1956 and approved by the State Water Policy Commission with the provision that the stop planks would be cut down to an elevation no higher than +69.75 MSL. In 1959 after it became apparent that the concrete spillway was unable to handle heavy flows, two asphalt auxiliary spillways were added. In reviewing the records, it appears there had been long-term problems concerning the maintained level of the lake. Apparently, lake-shore residents complained that the lake was too shallow for swimming in front of their property. The development company raised the level where it began to flood basements of residents located along the Black Horse Pike. During heavy rains, the lake rose still higher where additional surrounding properties became flooded. After numerous complaints and a death attributed to attempting to remove the stopplanks during a flood, the Water Policy Commission ordered a lowering of the lake and the addition of the auxiliary spillways. A 1959 inspection revealed heavy surface erosion and immediate repair was deemed necessary (and was performed). The lake was most recently dewatered in 1965 for repairs and replacement of the flashboards.

h. Normal Operating Procedures

There are at present no specific operating procedures at this site except for the periodic maintenance of the spillway. The dam operates as an non-controlled structure (see Section 4).

1.3 PERTINENT DATA

a. Drainage Area

The drainage area of Cushman Lake Dam is 27.8 square miles.

b. Discharge of Dam Site

The spillway capacity with the reservoir at the dam crest elevation is calculated to be 3,410 cfs. No discharge records are available at this site.

c. Elevation (Above M.S.L.)

Top of dam - +75.0

Effective top elevation for hydraulic analysis - +74.0

Recreation pool - +70.0

Streambed at center line of dam - +58.0

d. Reservoir

Length of recreation pool - 3,650 feet (Cushman Lake)
Length of maximum pool - 12,600 feet

e. Storage (Cushman Lake alone)

Recreation pool - 400 acre-ft.

Top of dam - 1,940 acre-ft. (Cushman Lake)

Top of dam - 2,111 acre-ft. (Cushman plus upstream lakes)

f. Reservoir Surface

Top of dam - 554 acres (Cushman Lake)

Top of dam - 576 acres (Cushman plus upstream lakes)

Recreation pool - 62 acres (Cushman Lake)

Recreation pool - 108 acres (Cushman plus upstream lakes)

g. Dam

Type - Earth embankment with concrete spillway

Length - 780 feet

Height - 17.5 feet (concrete culvert structure)

Freeboard between normal reservoir and top of dam - 5 feet

Top width - 12+ feet (design dimension); varies (in field).

Side slopes - 1:1 (varies)

Zoning - composition and compactness unknown

h. Diversion and Regulating Tunnel

None

i. Spillways

1) Type - reinforced concrete frame with timber flashboards.

Length of weir - 30 feet (effective)

Crest Elevation - +70.0 (flashboards in place)

2) Type - auxiliary weirs (2) in dam crest

Length - 1 @ 90', 1 @ 100'

Crest elevation - +71±

j. Regulating Outlets

Removable flashboards in three of the concrete spillway sections. Minimum invert elevation is +62.0 (flashboards removed)

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The design information available for review were the 1953 construction plans for the spillway (see Figure 2 and 3). The design was undertaken by Mr. A. Bernard, N.J.P.E. #3725, to American Concrete Institute and Concrete Reinforcing Steel Institute specifications. It is unknown to what capacity the 20-foot long cedar piles were driven but the total dead load is less than 12 tons per pile. The design mix employed for the concrete was 2000 psi but the details of the placement of the reinforcing bars was not indicated nor were any design computations available for review.

2.2 CONSTRUCTION

Nothing is known about the construction except the 1953 work was placed over an earlier embankment which was reputedly built in 1936. The construction was a part of a series of recreation dams to stabilize the lake levels within the sub-division development.

2.3 OPERATION

The records indicate that the concrete spillway required additional assistance to supplement its hydraulic capacity. The dam appears to have operated satisfactorily as designed since the installation of the auxiliary spillways.

2.4 EVALUATION

a. Availability

In view of the size and hazard classification it is felt that sufficient engineering data is available except for the geotechnical composition of the embankment.

b. Adequacy

The original plans reveal that the spillway was conservatively designed and from the results of the field inspection, is built in accordance with

the design plans. Although no details are available regarding the placement of reinforcing, the plans are adequate for engineering assessment purposes.

c. Validity

Based on field observations, the validity of the 1955 design plans is not challenged but further investigations would be required in the future to assess the permeability of the embankment and its longterm stability (see Section 7).

SECTION 3 - VISUAL INSPECTIONS

3.1 FINDINGS

a. General

The visual inspections were conducted on January 2, 11 and February 23, 1979. The reservoir water level at the time of the initial inspection was about 4 inches above the top of the intake flashboards and was flowing freely. Most of the lake and surrounding embankment were in a frozen condition.

b. Dam

The upper zones of the dam embankment were found to be in a poor condition reflecting its age and apparent lack of maintenance. The crest has a considerable variation in width and elevation and all vestiges of its geometric design dimensions are obliterated. The lake level appears to be quite constant during most periods as the banks are fairly well stabilized and show only minor evidence of sloughing at the waterline. However, the upper zones of the dam foreslopes are badly eroded and undercut in many areas. The backslopes are partially grassed over and contain several large trees and secondary growth. There is evidence of considerable surface run-off and erosion in numerous locations below the dam crest which have incised rather deep erosion gullies, especially at the corners of the spillway wingwalls and an extensive zone north of the spillway. The steeper upstream embankment slopes are very irregular and it appears the lake has silted up considerably against the upstream face. The backslopes show evidence of numerous wet areas at the lower elevations, but most of this appears to be at the natural swamp elevation downstream and not the result of percolation through the dam embankment. The dam crest is extremely rough and requires additional clay binder in the fill material to stabilize the surface which now is in a loose condition as a result of vehicular traffic. The dam is continually being used as an illegal short-cut

exit from the residential neighborhood to the south. Cars and trail bikes have done extensive damage to the embankment at the south wall of the spillway where the crest is now only 3 to 4 feet wide and in imminent danger of breaching, especially if the illegal vehicular traffic continues.

The embankment to the right of the south auxiliary spillway is severely disfigured by the rutting and several areas are only between one to two feet above the auxiliary spillway crest. There also appears to be an area of embankment subsidence or shear failure to the left of the spillway as evidenced by a severe tipping of the telephone pole in this area. However, this appears to have occurred many years ago and is not the result of a recent subsidence. The upper exposed zones of the embankment are composed principally of silty sand and sandy clay but the refilled and repaired areas are loose sandy gravel. The embankment does not have a timber core and is founded on recent alluvium overlying the organic swamp stratum. The exposed underlying soil in the vicinity of the right abutment is predominently loose sand with little cohesion.

c. Appurtenant Structures

The three-celled reinforced concrete culvert is in moderately good structural condition. Each opening of the culvert has a width of 6'-0" and a clear headroom of 16'-0". The wingwalls and transverse tiebeams display numerous cracked and spalled areas but the structurally important zones are in an integral condition. Its configuration is a modification of the Soil Conservation Service type of design prevalent during the period of construction and is extremely stable and structurally conservative. However, the downstream wingwalls which parallel the axis of the dam are too short to provide adequate sloped embankment returns into the channel. The concrete invert slab is founded on timber piling as are the main footings of the culvert walls and wings. Due to the depth of flow, the condition of the invert slab, could not be observed (at a subsequent inspection trip on 23 February 1979, this invert was still

submerged). Several visible areas of the vertical walls are badly chipped and spalled and need patching. The embankment fill behind each end of the wingwalls is seriously eroded to a depth of 4 to 5 feet. As previously stated, there is an apparent lack of binder in most of the embankment fill, especially near the exposed surfaces.

The drop inlet is a 3-sided reinforced concrete frame built monolithically into the culvert. Each of the 5 openings is 6'-0" wide and timber flashboards are positioned on vertical timber runners on the upstream face. The timber is in poor condition and the stoplogs appear to be wedged tightly into position. The concrete edges along the crest is badly chipped and spalled and there are no lifting devices for removal of the stoplogs.

The auxiliary spillways are 90 and 100 feet wide each and are positioned near each abutment. The spillway crest near the right abutment is roughly one foot higher than the left one. Both are paved with asphalt and are in fairly good condition with only minor cracks and ravelling at the edges. A surface drainage ditch has been recently cut immediately to the south of the right auxiliary spillway and is only a few inches above the lake elevation. This apparently was built to drain the tennis court and street immediately to the south of the dam. The effective dam height in this area is very low and there are no true backslopes as the dam blends into the naturally higher surrounding terrain.

d. Downstream Channel

The Hospitality Branch of the Great Egg Harbor River flows southeast below the dam in a heavily wooded, low marshy area between 800 to 1,000 feet wide. There is some minor scouring in the stream bed below the dam spillway before the exiting into the 30 to 40 foot wide clear channel. Above the undeveloped lowlands, the wooded banks gradually rise up several feet in to the residential areas. This immediate downstream area (before the stream passes

under Route 54 and the Pennsylvania-Reading Railroad) was originally planned to be "Robin's Lake" as part of the sub-division development but apparently was never dammed up. Beyond the highway, the flood plain broadens out further until it intercepts the Great Egg Harbor River roughly 1.6 miles below the dam.

e. Reservoir Area

Cushman Lake extends 3,650 feet up to another earth dam where a boat landing is located. This unnamed dam normally impounds Braddock, Cains Mill and Hospitality Lakes but was breached last July (see appended photograph). Therefore, at the present time, the study dam is impounding an additional 46 acres of lake area. It is unknown whether or not repairs are contemplated for the damaged structure. As can be seen in Section 5, the condition of this dam has negligible effect on the study dam. The banks of the connecting lakes are very flat and the surrounding residential areas are only a few feet above the normal lake pool.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Operational procedures were not physically observed by the inspection team. There is no day-to-day operation as the stoplogs are infrequently adjusted and appear to have not been removed since their 1965 replacement.

4.2 MAINTENANCE OF DAM
4.3 MAINTENANCE OF OPERATING FACILITIES

The dam and reservoir are maintained by the Collins Lakes Maintenance Group as part of their seasonal recreation program. The lake was last dewatered in 1965.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

None exists except for monitoring by local police during heavy storms.

4.5 EVALUATION

The present operational procedures for the spillway are felt to be adequate, in view of the position of the dam (no downstream residential areas) and the apparent satisfactory performance of the auxiliary spillways. The maintenance of the dam embankment however, has apparently been neglected for a considerable period and is deemed to be less than satisfactory.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

Pursuant to the Recommended Guidelines for Safety Inspection of Dams, Cushman Lake Dam is of intermediate size and significant hazard. In view of the low (4-10 feet) height of a considerable portion of the embankment and large uninhabited downstream flood plain, a spillway design flood of one half the probable maximum flood (½ PMF) was selected to test the spillway capacity and overtopping potential. Precipitation data was obtained from Hydrometeorological Report No. 33. In accordance with Corps of Engineers directives, the inflow hydrograph and flood routing were obtained utilizing the HEC-1 computer program. Peak inflow to the reservoir for one half the PMF was 3,150 cfs. The peak reduced to 3,080 cfs after the inflow was routed through the regular reservoir (assumming the upstream dam is repaired). If the routing is conducted thru the additional 46 acres of upstream lakes (the breached dam unrepaired), the outflow reduces to 3,070 cfs. The maximum main and auxiliary spillway discharge capacities before overtopping is calculated to be 3,410 cfs. Hence, the spillways can accommodate the spillway design flood (SDF).

b. Experience Data

According to the Dam Application No. 310, the dam was originally designed to accommodate a 50-year frequency event with a peak flow of 754 cfs. There are no records concerning overtopping of the dam, nor are any streamflow records available.

c. Visual Observations

The spillway appears to function adequately except it is noted that at extreme high heads, the additional vortex caused by the side weir inlets could possibly choke the outlet to a degree and slightly reduce the capacity. However, in view of the geometry and size of the design flood, this is thought to be of minor concern.

d. Overtopping Potential

As there are no recent records of the dam being overtopped and the fact that the three spillways can accommodate the design flood, there is only minor potential for overtopping.

e. Drawdown

At this present time, drawdown is not easily accommodated as the timber flashboards have no built-in method for removal and would have to be demolished to effect an lowering of the lake. However, in an emergency (with the planking removed), it would take roughly 6 hours to draw the lake down to the bottom of the timber openings (El. +62). There is no provision to further dewater the lake the remaining four feet to its original bottom elevation.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Based upon the field inspection of existing conditions and the single source of design plans, the structural stability of the spillway culvert is judged to be in a moderate to fair condition but certain sections of the embankment are marginal and are in dire need of rebuilding. The exposed spillway surfaces require superficial repair (mainly to eliminate or slow further deterioration) but its foundation and major structural elements are believed to be in a sufficiently integral condition. The deteriorated condition of the embankment crest and foreslopes is of major concern to the inspection team as the fill immediately south and abutting the spillway is almost completely eroded, leaving a crest width of only a few feet. Further, this width is constantly being diminished by the cars illegally driving over the dam. This zone could be easily breached after the ground thaws this spring. Additionally, the embankment between the right abutment and south auxiliary spillway is one to two feet below design crest elevation and could also be overtopped by normal spring flooding if discharges reach the auxiliary spillway crest.

b. Design and Construction Data

Although no hydraulic or structural computations were available, the review of the record plans indicate that the concrete intake and culvert structure were conservatively designed and in spite of their age, is believed to be in an adequate structural condition.

c. Operating Records

No records are available but the dam appears to be operating satisfactorily. The only known instances of overtopping occured prior to the installation of the auxiliary spillways.

d. Post Construction Changes

The only post-construction changes have been the replacement of embankment material at various times and the installation of new timber stoplog planking in 1967.

e. Seismic Stability

Cushman Lake Dam is located in Zone 1 and due to its low embankment height and spillway geometry, has negligible potential vulnerability regarding earthquake loadings. The depth to bedrock in the vicinity is thought to be over 100 feet and the dam is underlain with recent alluvium sands and silts with some clay (but of insufficient amounts to consider liquification a major concern). Experience indicates that dams in Zone 1 which have adequate factors of safety under static loads will be satisfactory to resist dynamic loading conditions.

SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/ PROPOSED REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

Subject to the inherent limitations of the Phase I visual inspection, Cushman Lake Dam is classified as being in a poor overall structural condition and the embankment is in immediate need of repair. It is built of unknown composition but due to its broad width to height ratio and lack of evidence of serious seepage, (except at the north auxiliary spillway) is felt to be of a sufficiently impervious condition to withstand normal hydraulic heads. The present spillway capacity is adequate and meets the requirements of the Recommended Guidelines for Safety Inspection of Dams, being able to accommodate the design flood as calculated by Corps of Engineers criteria. There is no economical or hydraulically feasible way to increase the present concrete spillway capacity without major reconstruction effort.

b. Adequacy of Information

The information gathered for the Phase I inspection is deemed to be adequate regarding the structural stability of the dam. However, no recent surveys have been made.

c. Urgency

It is recommended that the remedial measures enumerated below be immediately undertaken as the dam remains in a precarious condition in view of the incipient weak embankment condition adjacent to the main spillway.

d. Necessity for Further Study

Due to the downgraded significant hazard classification of the dam and the fact that little damage to the downstream bridges is foreseen in

the event of a failure, further engineering studies are deemed unnecessary.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

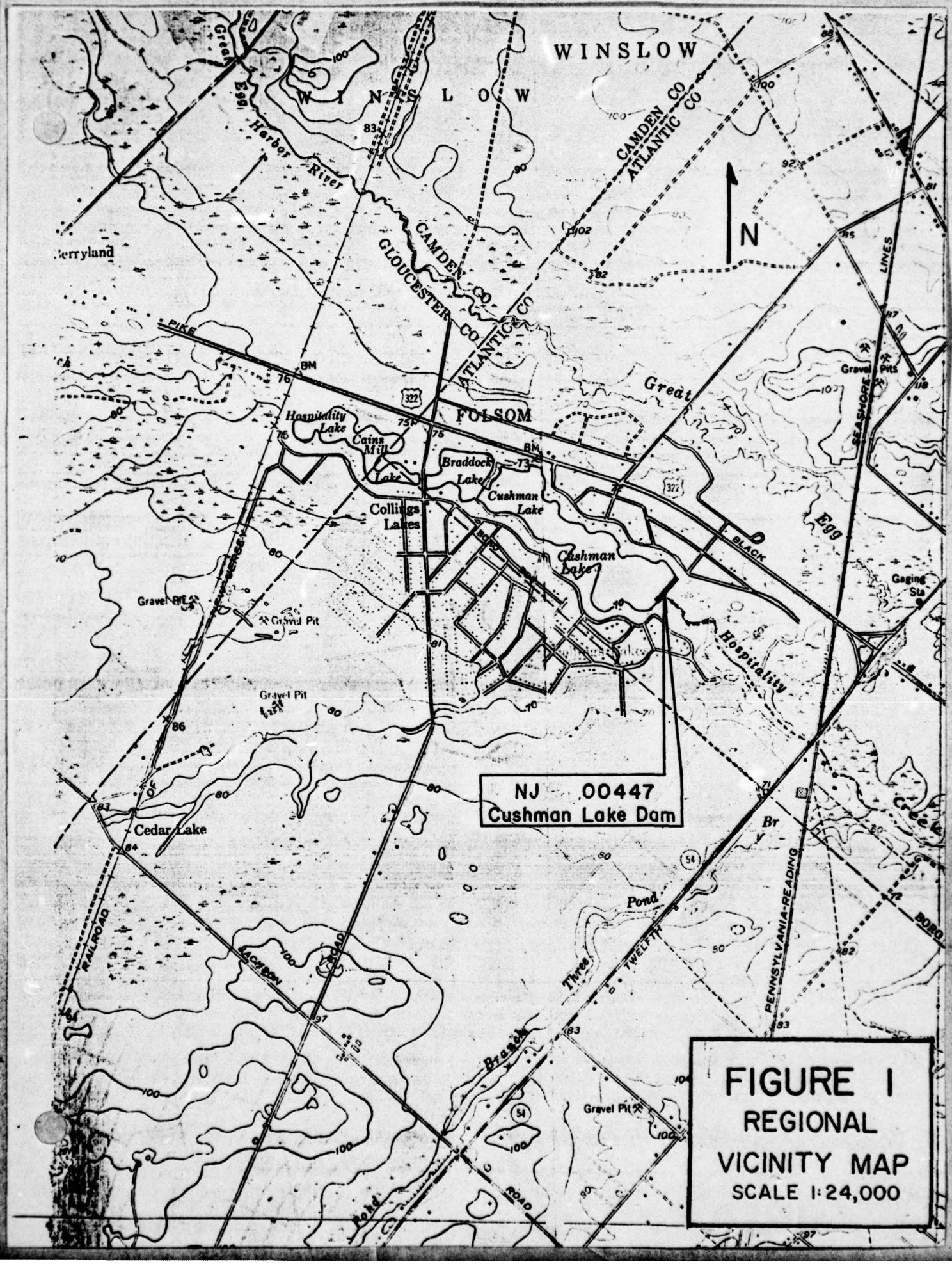
a. Recommended Actions

The entire crest of the embankment should be immediately scarified, recompacted and additional fill added to bring it up to proper line and grade. Additionally, the eroded backslopes should be filled in and protected with a suitable ground cover. On the basis of visual inspection, improvements to the present spillway should consist of repairing the exposed concrete surfaces, including sandblasting and applying epoxy-mortar coatings or dry-gunning. The joints should be cleaned out and recaulked. The keeper planks for the stoplogs should be rehabilitated. The embankment at each side of the downstream spillway wingwalls should be further protected with slope paving along the face of each wall. Other remedial measures to be taken under advisement very soon include:

- removal of the trees on the downstream embankment to lessen the piping potential;
- add riprap stone at the downstream pool immediately below the culvert outlet;
- seal up the cracks in the auxiliary spillways and repair undercut and ravelled edges;
- install timber posts at each abutment across the dam axis to prohibit vehicular traffic.

b. O&M Maintenance and Procedures

The maintenance of the dam has apparently been neglected in recent years. The owners should upgrade their annual preventative maintenance procedures and issue checklists for periodic inspections and record keeping.


WINSLOW
W I N S L O W
CAMDEN CO
ATLANTIC CO
GLOUCESTER CO
CAMDEN CO
ATLANTIC CO
N
Egg Harbor River
Berryland
PIKE
BM
322
FOLSOM
Hospitality Lake
Cains Mill Lake
Braddock Lake
Cushman Lake
Collings Lakes
Cushman Lake
Cushman Lake
BLACK
Egg
Great
SEASHORE LINES
Gravel Pits
Gaging Sta
Hospitality
Gravel Pit
Gravel Pit
Gravel Pit
NJ 00447
Cushman Lake Dam
Cedar Lake
RAILROAD
JACKSON
ROAD
Three
TWELFTH
Pond
PENNSYLVANIA-READING
BORO
Br
Gravel Pit
Branch
ROAD
FIGURE 1
REGIONAL
VICINITY MAP
SCALE 1:24,000

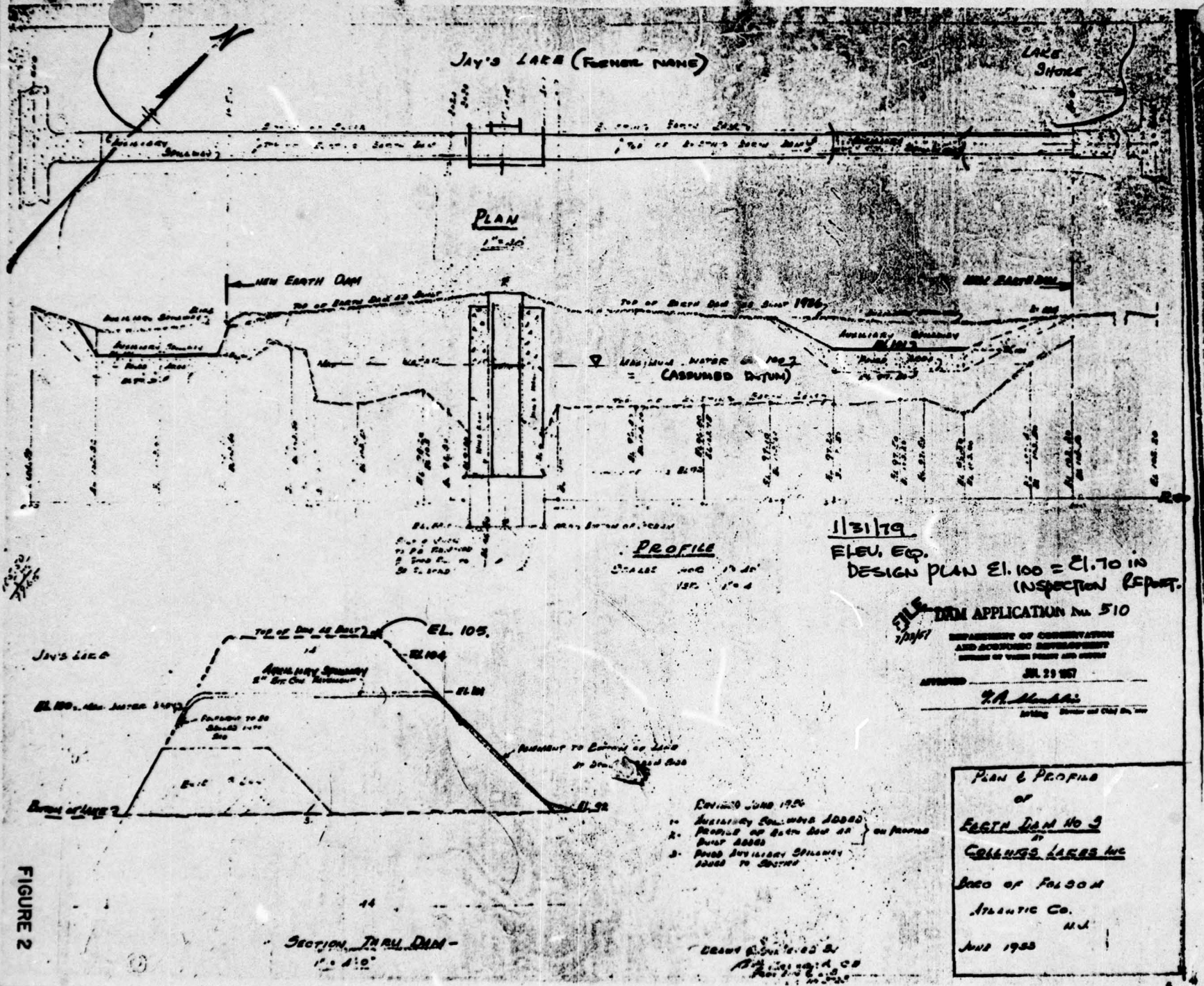

JAY'S LAKE (FORMER NAME)
LAKE SHORE
PLAN
NEW EARTH DAM
EXISTING EARTH DAM
AUXILIARY SPILLWAY
EL. 103
(ASSUMED DATUM)
PROFILE
1/31/79
ELEV. EQ.
DESIGN PLAN EL. 100 = EL. 70 IN
INSPECTION REPORT.
DAM APPLICATION No. 510
APPROVED JUL 29 1957
EL. 105.
EL. 104
EL. 101
EL. 92
JAY'S LAKE
AUXILIARY SPILLWAY
BOTTOM OF LAKE
REVISED JUNE 1956
1. AUXILIARY SPILLWAY ADDED
2. PROFILE OF EARTH DAM AS BUILT ADDED
3. REVISED AUXILIARY SPILLWAY ADDED TO SECTION
SECTION THRU DAM
PLAN & PROFILE
OF
EARTH DAM NO 2
FOR
COLLINGS LAKES INC
BORO OF FOLSOM
ATLANTIC CO.
N.J.
JUNE 1955

FIGURE 2

ORIG

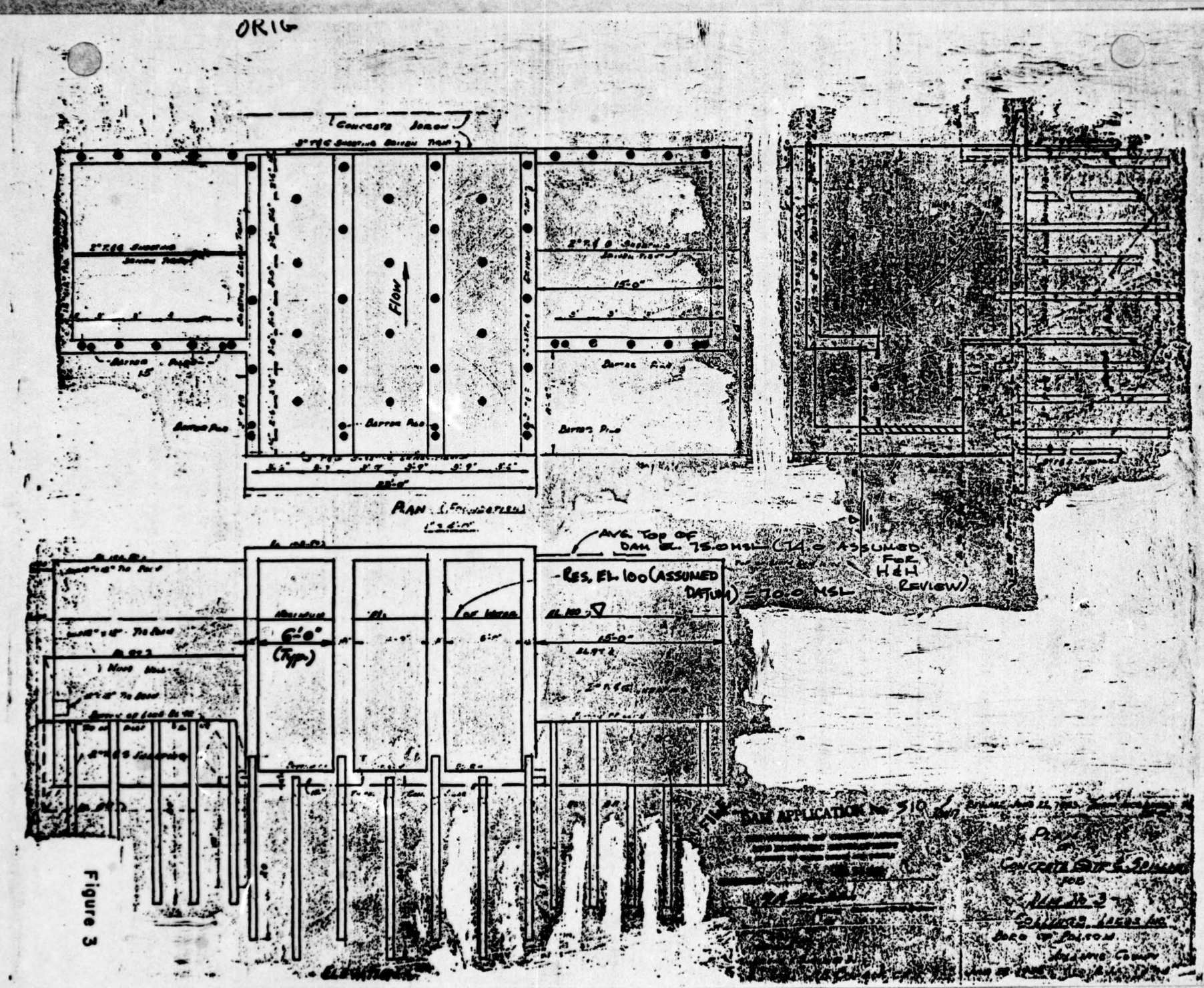


Figure 3

ORIG

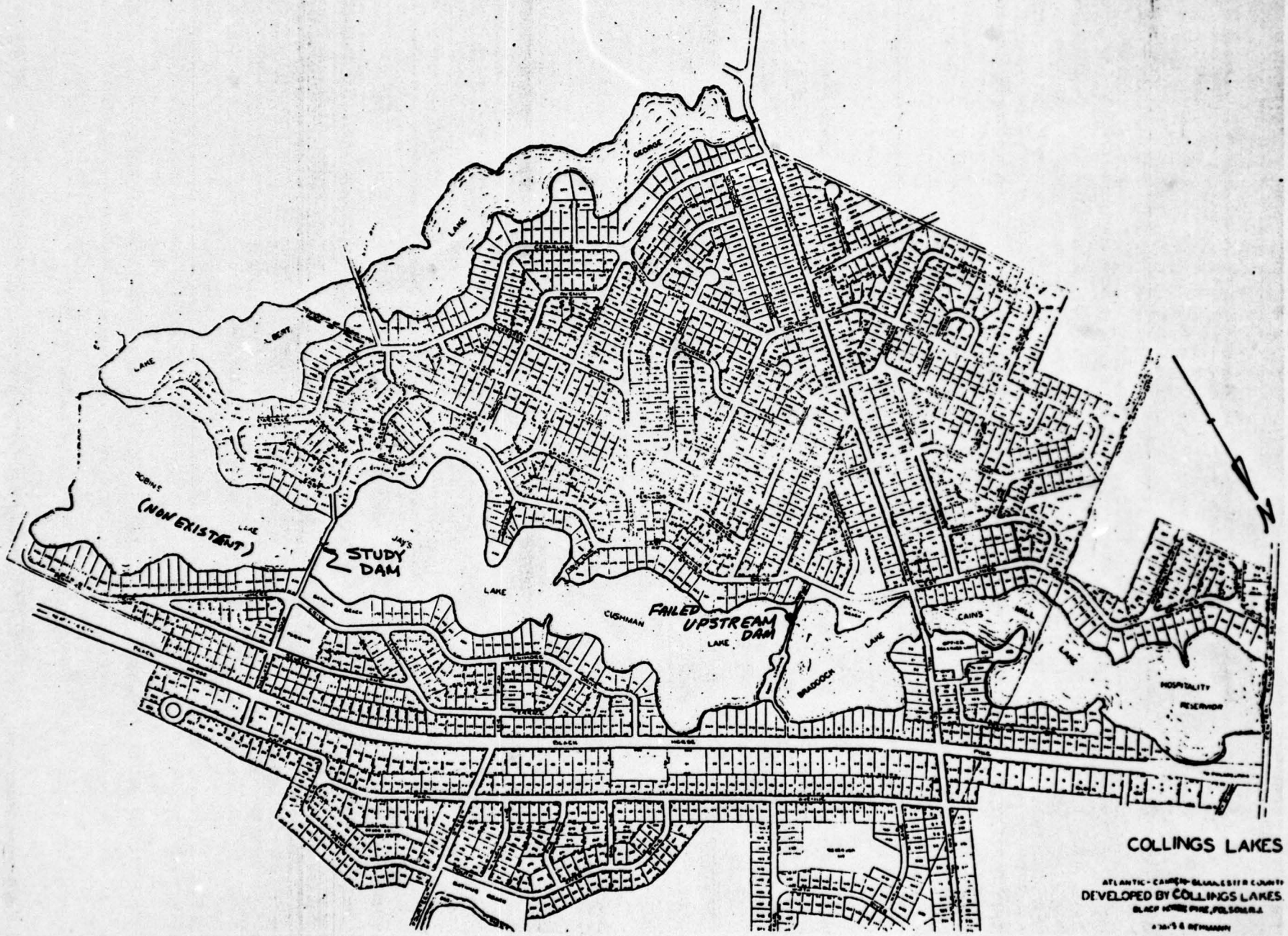


Figure 4

Check List
Visual Inspection
Phase 1

Name Dam Cushman Lake County Atlantic State New Jersey Coordinators NJDEP

Date(s) Inspection 2 Jan. 1979, 11 Jan. 1979, 23 Feb. 1979 Weather Clear Temperature 18°

Pool Elevation at Time of Inspection + 70 M.S.L. Tailwater at Time of Inspection + 62 M.S.L.

Inspection Personnel:

K. Jolls

R. Lang

E. Simone

K. Jolls Recorder

Dam No. 00447

EMBANKMENT DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEE PAGE ON LEAKAGE		
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Poor condition - slumping and erosion at junctions.	
DRAINS	None	
WATER PASSAGES	None	
FOUNDATION	Timber piling	

CONCRETE/MASONRY DAMS
(SPILLWAY)

VISUAL EXAMINATION OF	OBERSVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Heavy spalling at inlet.	
STRUCTURAL CRACKING	Minor cracking.	Timber flashboards are in poor condition, some missing others rotted.
VERTICAL AND HORIZONTAL ALIGNMENT	Satisfactory at spillway structure (top slab)	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Numerous, all geometric lines destroyed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	Slopes poor condition. (Embankment of sand with trace gravel and silt - no binder)	Side ditch cut behind right abutment (to drain street and tennis court area).
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Depressed sloughing and scouring severe erosion on slopes.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Poor condition.	Area at left abutment at approximate lake level.
RIPRAP FAILURES	N/A	

EMBANKMENT

'ISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
'UNCTION OF EMBANKMENT ND ABUTMENT, SPILLWAY ND DAM	Poor condition, severe erosion at spillway structure.	
.NY NOTICEABLE SEEPAGE	Yes, to left of main spillway low area in downstream ground level.	Leaning telephone pole indicating settlement.
TAFF GAGE AND RECORDER	None	
RAINS	None	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Minor spalling.	
INTAKE STRUCTURE	See concrete weir section.	
OUTLET STRUCTURE	3-6' x 16.5' concrete culverts	
OUTLET CHANNEL	See downstream channel section.	
EMERGENCY GATE	2 - depressed asphalt covered overflow sections 1 @ 100' long 1 @ 90' long	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Reinforced concrete frame with timber flashboard. 5 - openings each 5' x 6'.	
APPROACH CHANNEL	None - Cushman Lake directly above dam and spillway.	
DISCHARGE CHANNEL	Natural channel, flat slopes 25-30' wide.	Heavily wooded banks.
BRIDGE AND PIERS	None	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	None	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Flat	
SEDIMENTATION	Minor	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Heavily wooded and brush on banks.	
SLOPES	Very flat.	
APPROXIMATE NO. OF HOMES AND POPULATION	None immediately downstream.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Available (All material from NJDEP records)
REGIONAL VICINITY MAP	Available
CONSTRUCTION HISTORY	Available
TYPICAL SECTIONS OF DAM	Available
HYDROLOGIC/HYDRAULIC DATA	Some available
OUTLETS - PLAN	Available
- DETAILS	Available
-CONSTRAINTS	Available
-DISCHARGE RATINGS	Available
RAINFALL/RESERVOIR RECORDS	None available

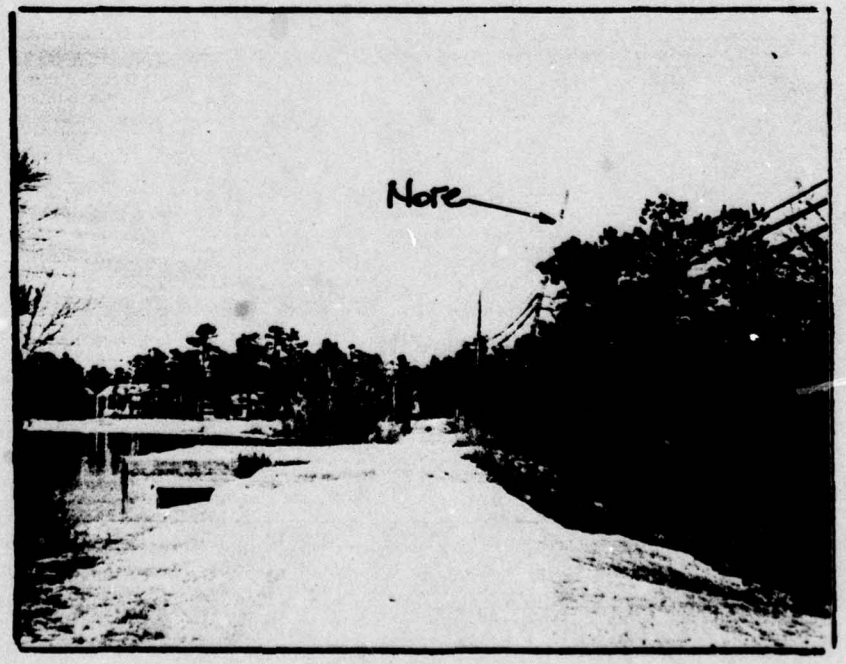
ITEM	REMARKS
DESIGN REPORTS	None available
GEOLOGY REPORTS	None available
DESIGN COMPUTATIONS	Some available
HYDROLOGY & HYDRAULICS	Some available
DAM STABILITY	Unknown
SEEPAGE STUDIES	Unknown
MATERIALS INVESTIGATIONS	Unknown
BORING RECORDS	Unknown
LABORATORY	Unknown
FIELD	Unknown
POST-CONSTRUCTION SURVEYS OF DAM	Unknown
BORROW SOURCES.	Unknown

ITEM	REMARKS
MONITORING SYSTEMS	Not applicable
MODIFICATIONS	Not applicable
HIGH POOL RECORDS	Unknown
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Unknown
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE OPERATION RECORDS	None available

ITEM	REMARKS
SPILLWAY PLAN	Available
SECTIONS	Available
DETAILS	Available
OPERATING EQUIPMENT PLANS & DETAILS	Not applicable

Intake structure

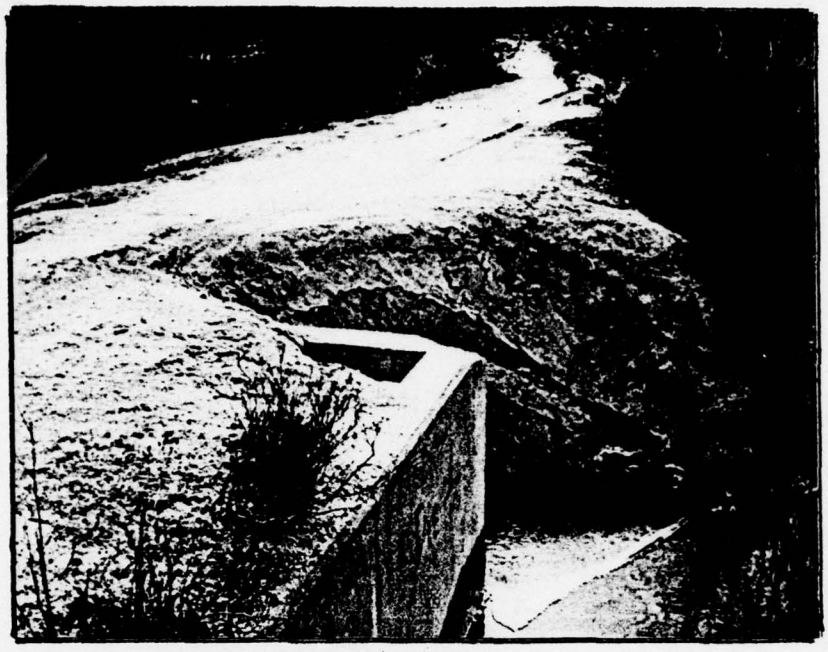
January 1979



Dam crest

(Note: lean of telephone pole)

January 1979

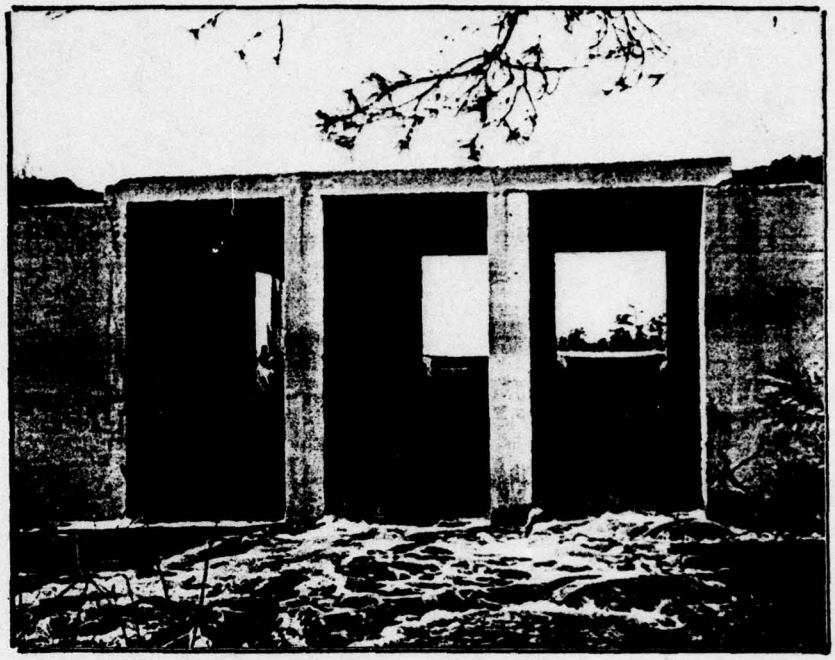


Severe erosion and sloughing right of spillway

January 1979

View North along dam crest

January 1979

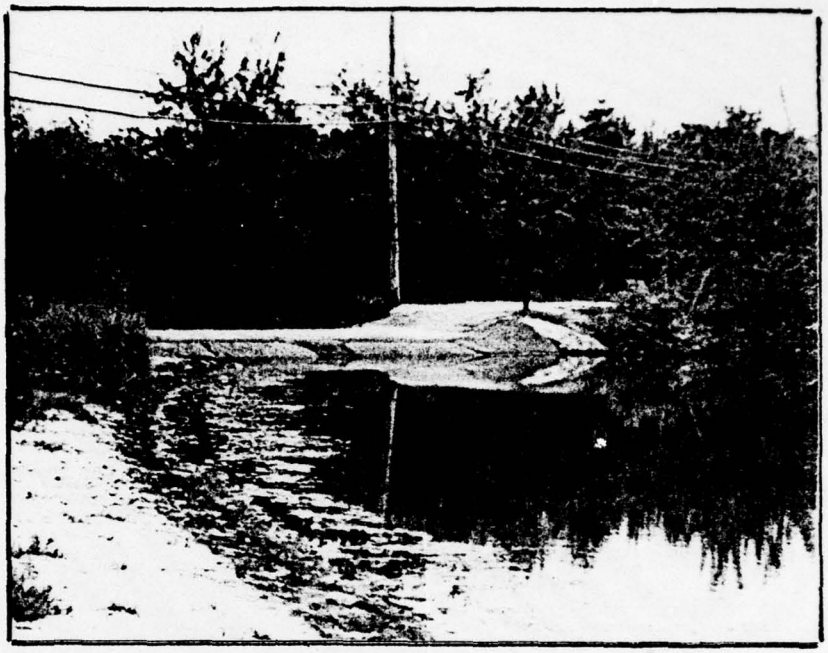


Outlet structure

January 1979

Auxiliary spillway near right abutment

January 1979



Auxiliary spillway near right abutment

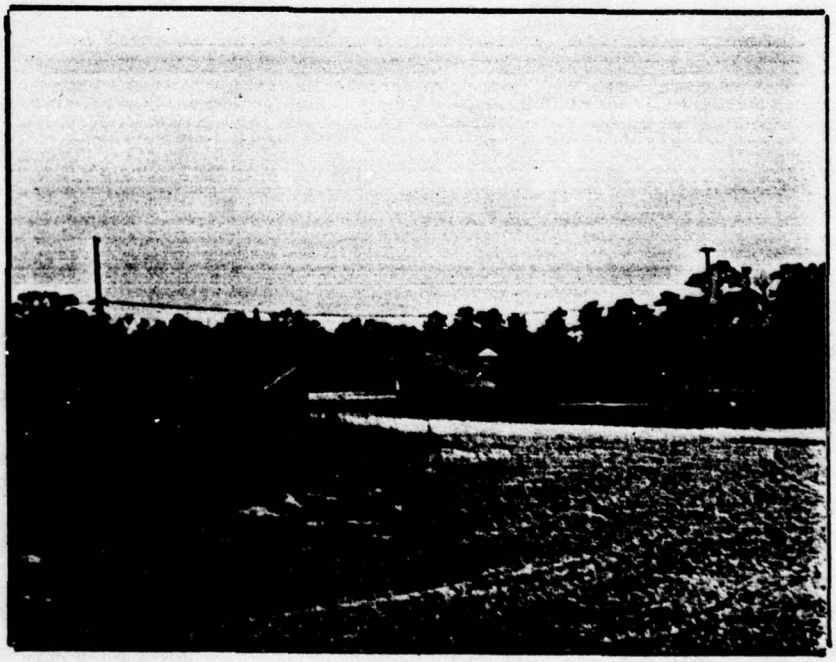
September 1978

Beach area and private homes at north end

January 1979

Upstream dam failure

January 1979



Cains Mill Road Bridge

January 1979

Downstream channel

January 1979

Cushman Lake

January 1979

Dam No. 00447

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Drainage Area = 27.8 sq.mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): + 70 M.S.L. (400 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): + 75 M.S.L. (1940 acre-feet)

ELEVATION MAXIMUM DESIGN POOL:

ELEVATION TOP DAM: + 75 M.S.L. (+74 for hydraulic review)

CREST:

a. Elevation + 70.0 M.S.L.
b. Type Narrow crested weir
c. Width 1.0'
d. Length 30'
e. Location Spillover 350' from left abutment
f. Number and Type of Gates None

OUTLET WORKS: 2 - auxiliary spillways 1 @ 90'; 1 @ 100'

a. Type Broad crested weirs
b. Location Left and right abutments
c. Entrance inverts + 71 M.S.L.
d. Exit inverts
e. Emergency draindown facilities

HYDROMETEOROLOGICAL GAGES: None

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 3410 CFS

BY D.J.M DATE 1-79 **LOUIS BERGER & ASSOCIATES INC.** #13 SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ CUSHMAN LAKE DAM INSPECTION PROJECT C226

SUBJECT ____

Unitgraph Data

Length of longest watercourse $L = 9.8$ miles

Length to centroid $L_c = 5.45$ miles

$LL_c = 9.8 \times 5.45 = 53.41$

from Curve # 1 Overleaf

$t_p = 39$ hours

C_p (from Corps) $= 0.60$

PRECIPITATION

PMF for 200 square miles & 24 hours duration = 24"

Maximum 6 hour percentage = 103 %

Maximum 12 hour percentage = 113 %

Maximum 24 hour percentage = 122 %

Maximum 48 hour percentage = 134 %

BY. D. J. M. DATE 1-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ CUSHMAN LAKE DAM INSPECTION PROJECT C-226

SUBJECT ____

Spillway discharge capacity

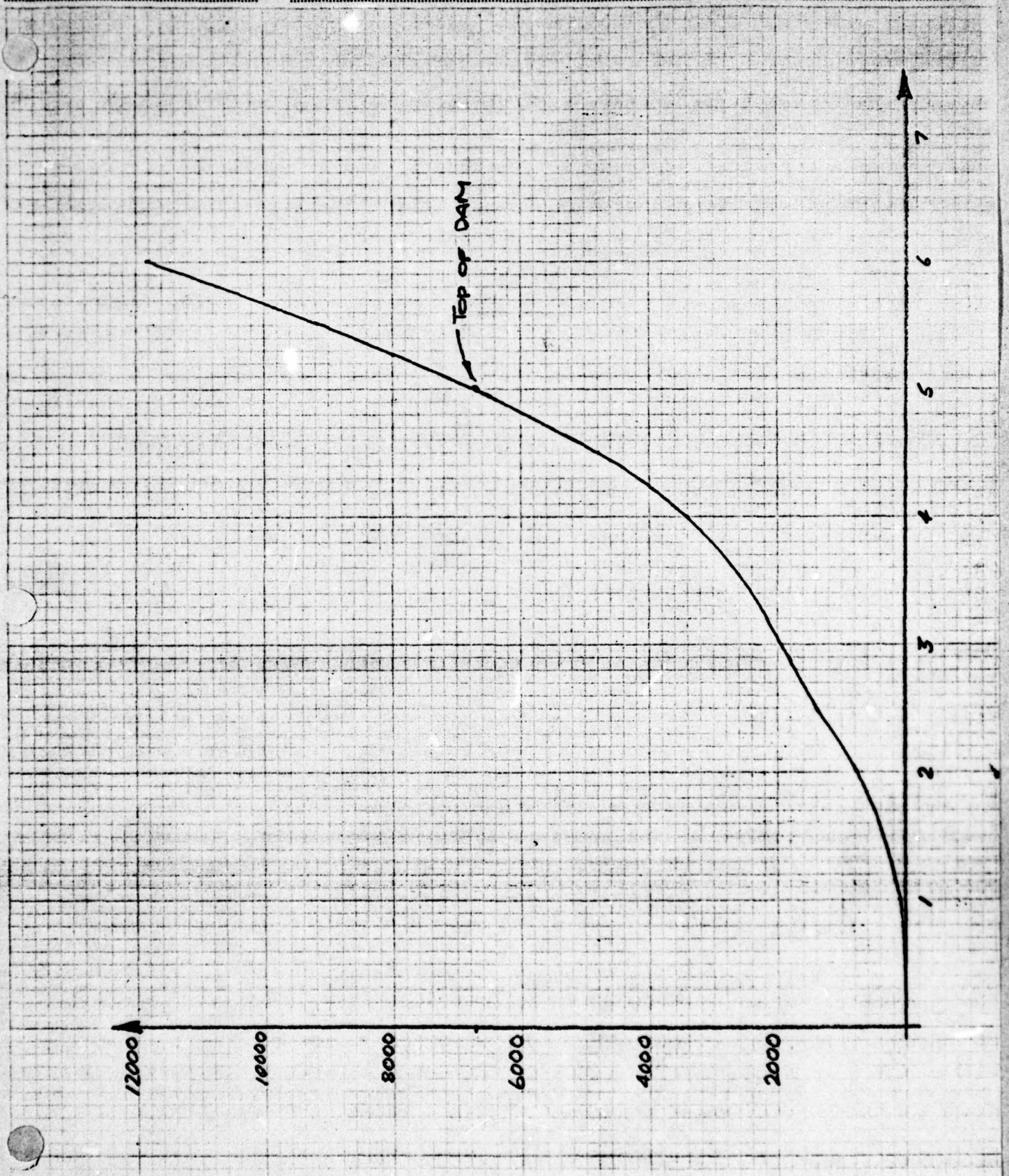
Over Auxillary Spillways L = 190'			Through spillway as weir L = 30'			Through spillway as culvert C = 0.55	
H	C	Q	H	C	Q	H	Q
			1	3.1	93		
1	2.7	513	2	3.1	263		
2	2.7	1451	3	3.1	483		
3	2.7	2666	4	3.1	744		
4	2.7	4104	5	3.1	1040		
5	2.7	5736				6	1622
6	2.7	7540				7	1752
7	2.7	9501				8	1873
8	2.7	11608				9	1986

Over dam L = 590'			ΣQ	
H	C	Q	H	Q
			1	93
			2	776
			3	1934
			4	3410
1	2.7	1593	5	6737
2	2.7	4506	6	11864
3	2.7	8277	7	17569
4	2.7	12744	8	24118
5	2.7	17810	9	31404

BY D.J.M. DATE 1-79
CHKD. BY ..... DATE .....

SUBJECT STAGE DISCHARGE CURVE
CUSHMAN LAKE DAM INSPECTION

SHEET NO. 43 OF .....
JOB NO. C226



BY. D. J. M. DATE 4-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A4 OF...

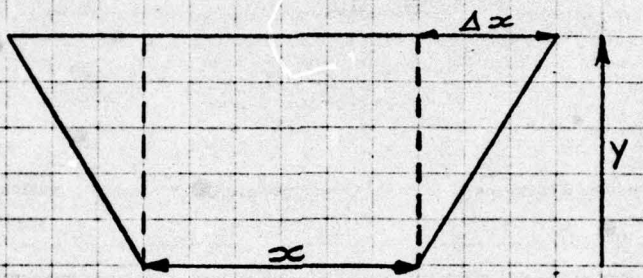
CHKD. BY..... DATE..... CUSHMAN LAKE DAM INSPECTION PROJECT C-226

SUBJECT.....

Area of lake @ El. 70± = 61.6 acres

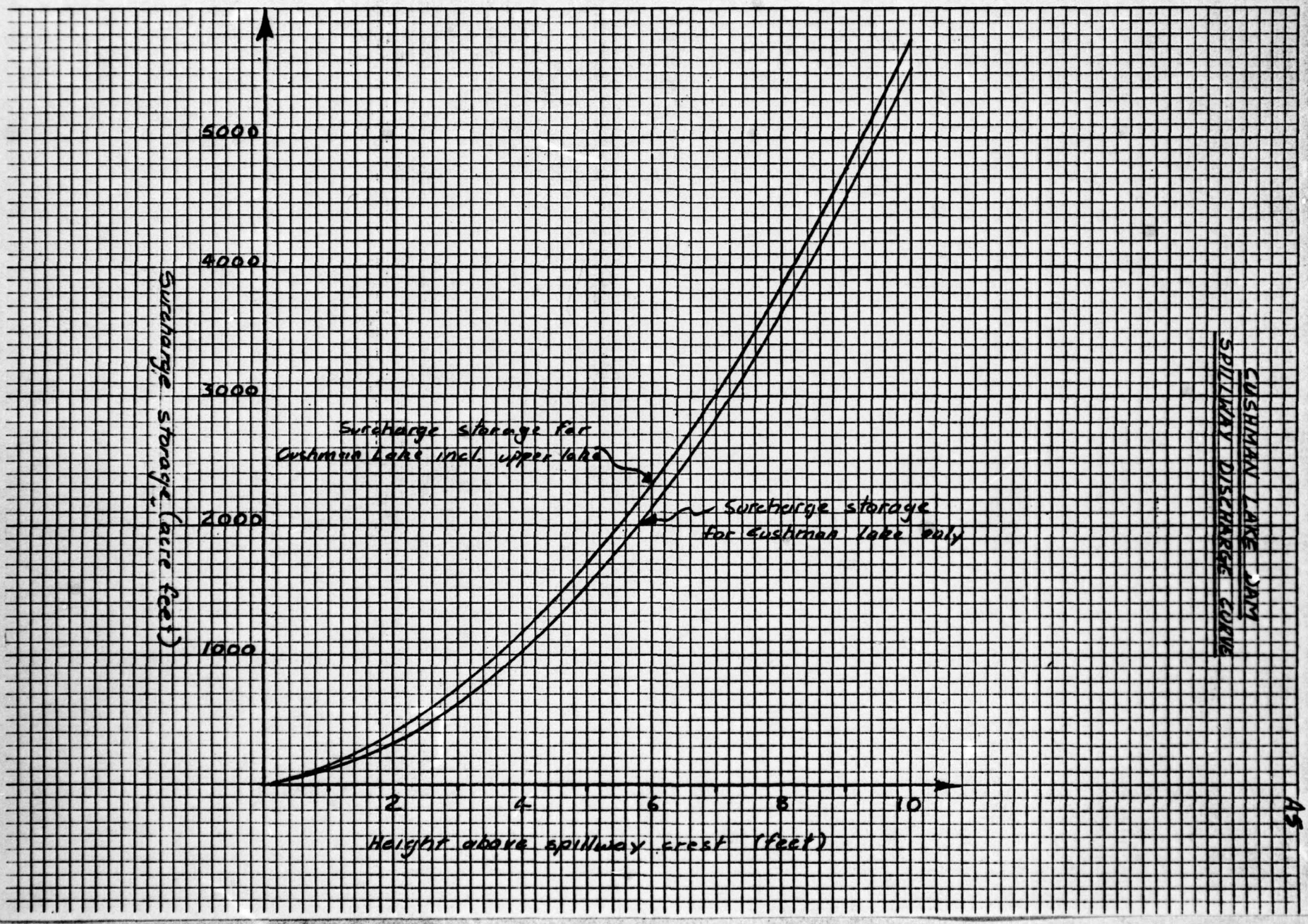
Area if added to upstream lake = 107.6 acres

Area of contour @ El. 80 = 1046 acres



Increment in volume $\Delta V = (x + \Delta x)y$

Height above spillway crest (feet)	Surcharge storage (acre feet)	Surcharge storage incl. upper lake (acre feet)
1	111	155
2	320	403
3	628	745
4	1034	1181
5	1539	1711
6	2142	2335
7	2843	3052
8	3643	3864
9	4541	4769
10	5538	5768



BY DL DATE

CHKD. BY DATE

SUBJECT

LOUIS BERGER & ASSOCIATES INC.

CUSHMAN LAKE DAM INSPECTION

DRAWDOWN CAPACITY

SHEET NO. A6 OF

PROJECT C-226

STORAGE OF LAKE @ EL. 70 = 400 AC-F

= 17.42×10^6 ft^3.

CAPACITY OF 5-WEIRS WITH FLASHBOARDS REMOVED

ASSUME AVG. HEAD OF 4'

$Q = CLH^{3/2}$

$= 3.3 \times 6 \times 4^{1.5}$

$= 158.40 \times (5)$

$= 792$ cfs

Time required to draw lake down from El. 70 to El. 62

$$= \frac{17.42 \times 10^6}{792 \times 3600} = 6.1 \text{ hours}$$

CUSHMAN LAKE DAM INSPECTION SOUTH GROUP C226
BY D.J.MULLIGAN
JANUARY 1979

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	6	0	0	0	0	0	0	0	0

JOPER	NWT
5	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1
RTIOS= 1.00 0.50 0.40 0.20 0.10

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
13	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	27.80	0.0	27.80	0.0	0.0	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	24.00	103.00	113.00	122.00	134.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.833

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	0.50	0.10	0.0	0.0

UNIT HYDROGRAPH DATA
TP= 39.00 CP=0.60 NTA= 0

RECESSION DATA
STRTQ= 0.0 QRCSN= 0.0 RTIOR= 1.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 7.38 AND R= 6.49 INTERVALS

UNIT HYDROGRAPH 39 END-OF-PERIOD ORDINATES, LAG= 39.00 HOURS, CP= 0.60 VOL= 1.00

15.	56.	111.	173.	228.	265.	279.	263.	229.	196.
169.	144.	123.	106.	91.	78.	67.	57.	49.	42.
36.	31.	26.	23.	19.	17.	14.	12.	10.	9.
8.	7.	6.	5.	4.	4.	3.	3.	2.	

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.07	0.00	0.
2	0.20	0.00	0.

BY D.J.M. DATE 4-79 LOUIS BERGER & ASSOCIATES INC. SHEET NO. A7 OF
CHKD. BY DATE CUSHMAN LAKE DAM INSPECTION PROJECT C226
SUBJECT

LOUIS BERGER & ASSOCIATES INC.

COSHMAN LAKE DAM INSPECTION

3	2.03	1.26	19.
4	0.11	0.00	70.
5	0.72	0.12	142.
6	2.00	1.40	246.
7	20.59	19.99	681.
8	1.08	0.48	1629.
9	0.0	0.0	2866.
10	0.0	0.0	4187.
11	0.0	0.0	5334.
12	0.0	0.0	6070.
13	0.0	0.0	6306.
14	0.0	0.0	5921.
15	0.0	0.0	5156.
16	0.0	0.0	4419.
17	0.0	0.0	3787.
18	0.0	0.0	3245.
19	0.0	0.0	2780.
20	0.0	0.0	2382.
21	0.0	0.0	2041.
22	0.0	0.0	1749.
23	0.0	0.0	1499.
24	0.0	0.0	1284.
25	0.0	0.0	1100.
26	0.0	0.0	943.
27	0.0	0.0	808.
28	0.0	0.0	692.
29	0.0	0.0	593.
30	0.0	0.0	508.
31	0.0	0.0	435.
32	0.0	0.0	373.
33	0.0	0.0	320.
34	0.0	0.0	274.
35	0.0	0.0	235.
36	0.0	0.0	201.
37	0.0	0.0	172.
38	0.0	0.0	148.
39	0.0	0.0	127.
40	0.0	0.0	108.
41	0.0	0.0	93.
42	0.0	0.0	77.
43	0.0	0.0	66.
44	0.0	0.0	56.
45	0.0	0.0	46.
46	0.0	0.0	1.
47	0.0	0.0	0.
48	0.0	0.0	0.
49	0.0	0.0	0.
50	0.0	0.0	0.
51	0.0	0.0	0.
52	0.0	0.0	0.
53	0.0	0.0	0.
54	0.0	0.0	0.
55	0.0	0.0	0.
56	0.0	0.0	0.
57	0.0	0.0	0.
58	0.0	0.0	0.
59	0.0	0.0	0.
60	0.0	0.0	0.
61	0.0	0.0	0.
62	0.0	0.0	0.
63	0.0	0.0	0.

64	0.0	0.0	0.
65	0.0	0.0	0.
66	0.0	0.0	0.
67	0.0	0.0	0.
68	0.0	0.0	0.
69	0.0	0.0	0.
70	0.0	0.0	0.
71	0.0	0.0	0.
72	0.0	0.0	0.
73	0.0	0.0	0.
74	0.0	0.0	0.
75	0.0	0.0	0.
76	0.0	0.0	0.
77	0.0	0.0	0.
78	0.0	0.0	0.
79	0.0	0.0	0.
80	0.0	0.0	0.
81	0.0	0.0	0.
82	0.0	0.0	0.
83	0.0	0.0	0.
84	0.0	0.0	0.
85	0.0	0.0	0.
86	0.0	0.0	0.
87	0.0	0.0	0.
88	0.0	0.0	0.
89	0.0	0.0	0.
90	0.0	0.0	0.
91	0.0	0.0	0.
92	0.0	0.0	0.
93	0.0	0.0	0.
94	0.0	0.0	0.
95	0.0	0.0	0.
96	0.0	0.0	0.
97	0.0	0.0	0.
98	0.0	0.0	0.
99	0.0	0.0	0.
100	0.0	0.0	0.
101	0.0	0.0	0.
102	0.0	0.0	0.
103	0.0	0.0	0.
104	0.0	0.0	0.
105	0.0	0.0	0.
106	0.0	0.0	0.
107	0.0	0.0	0.
108	0.0	0.0	0.
109	0.0	0.0	0.
110	0.0	0.0	0.
111	0.0	0.0	0.
112	0.0	0.0	0.
113	0.0	0.0	0.
114	0.0	0.0	0.
115	0.0	0.0	0.
116	0.0	0.0	0.
117	0.0	0.0	0.
118	0.0	0.0	0.
119	0.0	0.0	0.
120	0.0	0.0	0.
121	0.0	0.0	0.
122	0.0	0.0	0.
123	0.0	0.0	0.
124	0.0	0.0	0.

BY D. J. M. DATE 4-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A10 OF

CHKD. BY ______ DATE ______ CUSHMAN LAKE DAM INSPECTION PROJECT C226

SUBJECT ______

125	0.0	0.0	0.
126	0.0	0.0	0.
127	0.0	0.0	0.
128	0.0	0.0	0.
129	0.0	0.0	0.
130	0.0	0.0	0.
131	0.0	0.0	0.
132	0.0	0.0	0.
133	0.0	0.0	0.
134	0.0	0.0	0.
135	0.0	0.0	0.
136	0.0	0.0	0.
137	0.0	0.0	0.
138	0.0	0.0	0.
139	0.0	0.0	0.
140	0.0	0.0	0.
141	0.0	0.0	0.
142	0.0	0.0	0.
143	0.0	0.0	0.
144	0.0	0.0	0.
145	0.0	0.0	0.
146	0.0	0.0	0.
147	0.0	0.0	0.
148	0.0	0.0	0.
149	0.0	0.0	0.
150	0.0	0.0	0.
SUM	26.80	23.25	69189.

	PEAK	10-DAY	30-DAY	90-DAY	TOTAL VOLUME
CFS	6306.	1727.	577.	461.	69189.
INCHES		23.11	23.15	23.15	23.15
AC-FT		34266.	34326.	34326.	34326.

HYDROGRAPH AT STA 13 FOR PLAN 1, RTIO 1

0.	0.	19.	70.	142.	246.	681.	1629.	2866.	4187.
5334.	6070.	6306.	5921.	5156.	4419.	3787.	3245.	2780.	2382.
2041.	1749.	1499.	1284.	1100.	943.	808.	692.	593.	508.
435.	373.	320.	274.	235.	201.	172.	148.	127.	108.
93.	77.	66.	56.	46.	1.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	10-DAY	30-DAY	90-DAY	TOTAL VOLUME
CFS	6306.	1727.	577.	461.	69189.
INCHES		23.11	23.15	23.15	23.15
AC-FT		34266.	34326.	34326.	34326.

HYDROGRAPH AT STA 13 FOR PLAN 1, RTIO 2

0.	0.	10.	35.	71.	123.	340.	815.	1433.	2093.
2667.	3035.	3153.	2961.	2578.	2210.	1893.	1622.	1390.	1191.
1021.	875.	749.	642.	550.	471.	404.	346.	297.	254.
218.	187.	160.	137.	117.	101.	86.	74.	63.	54.

46.	39.	33.	28.	23.	1.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	10-DAY	30-DAY	90-DAY	TOTAL VOLUME
CFS	3153.	863.	288.	231.	34595.
INCHES		11.56	11.58	11.58	11.58
AC-FT		17133.	17163.	17163.	17163.

HYDROGRAPH AT STA 13 FOR PLAN 1, RTIO 3

0.	0.	8.	28.	57.	98.	272.	652.	1146.	1675.
2134.	2428.	2522.	2369.	2062.	1768.	1515.	1298.	1112.	953.
816.	700.	599.	514.	440.	377.	323.	277.	237.	203.
174.	149.	128.	110.	94.	80.	69.	59.	51.	43.
37.	31.	26.	23.	18.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	10-DAY	30-DAY	90-DAY	TOTAL VOLUME
CFS	2522.	691.	231.	185.	27676.
INCHES		9.24	9.26	9.26	9.26
AC-FT		13706.	13731.	13731.	13731.

HYDROGRAPH AT STA 13 FOR PLAN 1, RTIO 4

0.	0.	4.	14.	28.	49.	136.	326.	573.	837.
1067.	1214.	1261.	1184.	1031.	884.	757.	649.	556.	476.
408.	350.	300.	257.	220.	189.	162.	138.	119.	102.
87.	75.	64.	55.	47.	40.	34.	30.	25.	22.
19.	15.	13.	11.	9.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	10-DAY	30-DAY	90-DAY	TOTAL VOLUME
CFS	1261.	345.	115.	92.	13838.
INCHES		4.62	4.63	4.63	4.63
AC-FT		6853.	6865.	6865.	6865.

BY D.J.M DATE 4-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A12 OF

CHKD. BY ______ DATE ______ CUSHMAN LAKE DAM INSPECTION PROJECT C226

SUBJECT ______

HYDROGRAPH AT STA 13 FOR PLAN 1, RTIO 5

0.	0.	2.	7.	14.	25.	68.	163.	287.	419.
533.	607.	631.	592.	516.	442.	379.	324.	278.	238.
204.	175.	150.	128.	110.	94.	81.	69.	59.	51.
44.	37.	32.	27.	23.	20.	17.	15.	13.	11.
9.	8.	7.	6.	5.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	10-DAY	30-DAY	90-DAY	TOTAL VOLUME
CFS	631.	173.	58.	46.	6919.
INCHES		2.31	2.32	2.32	2.32
AC-FT		3427.	3433.	3433.	3433.

HYDROGRAPH ROUTING

ROUTING THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
113	1	0	0	0	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE=	0.	111.	320.	628.	1034.	1250.	1539.	2142.	2843.	3643.
OUTFLOW=	0.	93.	776.	1934.	3410.	4800.	6737.	11864.	17569.	24118.

STATION 113, PLAN 1, RTIO 1

0.	0.	3.	17.	48.	106.	426.	1102.	2203.	3472.
5060.	5862.	6269.	6075.	5405.	4637.	3981.	3409.	3033.	2605.
2232.	1912.	1634.	1400.	1199.	1028.	881.	756.	655.	562.
481.	412.	353.	303.	259.	222.	190.	163.	140.	120.
103.	91.	84.	76.	68.	52.	35.	23.	15.	10.
6.	4.	3.	2.	1.	1.	1.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STOR

0.	0.	4.	21.	57.	115.	213.	407.	702.	1044.
1287.	1408.	1469.	1440.	1340.	1225.	1123.	1034.	930.	812.

710.	622.	548.	486.	433.	387.	348.	314.	283.	254.
230.	209.	191.	175.	162.	151.	141.	132.	125.	119.
114.	108.	100.	91.	81.	63.	41.	27.	18.	12.
8.	5.	3.	2.	1.	1.	1.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	10-DAY	30-DAY	90-DAY	TOTAL VOLUME
CFS	6269.	1724.	577.	461.	69188.
INCHES		23.08	23.15	23.15	23.15
AC-FT		34216.	34326.	34326.	34326.

STATION 113, PLAN 1, RTIO 2

0.	0.	2.	9.	24.	49.	142.	532.	1084.	1739.
2350.	2825.	3080.	3058.	2784.	2414.	2070.	1771.	1516.	1299.
1113.	953.	817.	705.	608.	521.	446.	382.	328.	281.
241.	206.	177.	151.	130.	111.	95.	89.	82.	74.
66.	58.	50.	43.	37.	28.	19.	12.	8.	5.
3.	2.	1.	1.	1.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STOR

0.	0.	2.	10.	29.	59.	126.	245.	402.	576.
743.	873.	943.	937.	862.	760.	666.	585.	517.	459.
410.	367.	331.	298.	268.	242.	219.	200.	183.	168.
156.	146.	137.	129.	122.	117.	112.	106.	98.	88.
78.	69.	60.	52.	45.	34.	22.	15.	10.	6.
4.	3.	2.	1.	1.	1.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	10-DAY	30-DAY	90-DAY	TOTAL VOLUME
CFS	3080.	862.	288.	231.	34595.
INCHES		11.54	11.58	11.58	11.58
AC-FT		17105.	17163.	17163.	17163.

STATION 113, PLAN 1, RTIO 3

0.	0.	1.	7.	19.	39.	89.	417.	854.	1391.
1886.	2261.	2464.	2446.	2227.	1931.	1651.	1415.	1212.	1039.

BY D.J.M. DATE 4-79

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A14 OF

CHKD. BY ______ DATE ______

CUSHMAN LAKE DAM INSPECTION

PROJECT C226

SUBJECT ______

890.	764.	661.	568.	486.	417.	357.	306.	262.	225.
192.	165.	141.	121.	104.	91.	86.	78.	70.	62.
55.	48.	41.	35.	30.	23.	15.	10.	7.	4.
3.	2.	1.	1.	1.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STOR

0.	0.	2.	8.	23.	47.	107.	210.	341.	484.
615.	718.	774.	769.	709.	627.	553.	490.	436.	390.
350.	316.	285.	256.	231.	210.	192.	176.	163.	151.
141.	133.	126.	120.	114.	109.	102.	93.	84.	74.
65.	57.	49.	42.	36.	28.	18.	12.	8.	5.
3.	2.	1.	1.	1.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	10-DAY	30-DAY	90-DAY	TOTAL VOLUME
CFS	2464.	690.	231.	185.	27676.
INCHES		9.23	9.26	9.26	9.26
AC-FT		13684.	13731.	13731.	13731.

STATION 113, PLAN 1, RTIO 4

0.	0.	1.	3.	10.	20.	45.	134.	416.	675.
934.	1133.	1234.	1223.	1112.	963.	826.	712.	614.	526.
451.	387.	331.	284.	245.	208.	179.	153.	131.	112.
96.	89.	82.	74.	66.	58.	51.	45.	39.	33.
29.	25.	21.	18.	15.	12.	8.	5.	3.	2.
1.	1.	1.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STOR

0.	0.	1.	4.	11.	23.	53.	124.	210.	289.
362.	415.	442.	439.	409.	370.	333.	301.	270.	244.
221.	201.	184.	169.	157.	146.	137.	129.	123.	117.
112.	106.	98.	89.	79.	70.	61.	53.	46.	40.
34.	30.	25.	22.	18.	14.	9.	6.	4.	3.
2.	1.	1.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

BY D.J.M DATE 4-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A15 OF

CHKD. BY ______ DATE ________ CUSHMAN LAKE DAM INSPECTION PROJECT C226

SUBJECT

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	10-DAY	30-DAY	90-DAY	TOTAL VOLUME
CFS	1234.	345.	115.	92.	13838.
INCHES		4.61	4.63	4.63	4.63
AC-FT		6842.	6865.	6865.	6865.

STATION 113, PLAN 1, RTIO 5

0.	0.	0.	2.	5.	10.	22.	54.	145.	331.
461.	559.	612.	611.	560.	487.	418.	359.	307.	263.
226.	193.	166.	142.	122.	104.	92.	86.	78.	70.
62.	55.	48.	42.	36.	31.	27.	23.	20.	17.
15.	13.	11.	9.	8.	6.	4.	3.	2.	1.
1.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STOR

0.	0.	0.	2.	6.	12.	27.	65.	127.	184.
224.	254.	270.	270.	254.	232.	211.	192.	177.	163.
152.	142.	133.	126.	120.	114.	109.	102.	94.	84.
74.	65.	57.	50.	43.	37.	32.	28.	24.	20.
18.	15.	13.	11.	9.	7.	5.	3.	2.	1.
1.	1.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	10-DAY	30-DAY	90-DAY	TOTAL VOLUME
CFS	612.	172.	58.	46.	6919.
INCHES		2.31	2.32	2.32	2.32
AC-FT		3421.	3433.	3433.	3433.

********* ********** ********** ********** **********

PEAK FLOW SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS

OPERATION	STATION	PLAN	RATIOS APPLIED TO FLOWS 1.00	0.50	0.40	0.20	0.10
HYDROGRAPH AT	13	1	6306.	3153.	2522.	1261.	631.
		2	0.	0.	0.	0.	0.
ROUTED TO	113	1	6269.	3080.	2464.	1234.	612.
		2	0.	0.	0.	0.	0.

Routing through reservoir including storage from upper lake

HYDROGRAPH ROUTING

ROUTING THROUGH RESERVOIR (INCLUDING UPPER LAKE)

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
113	1	0	0	0	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE=	0.	155.	403.	745.	1181.	1446.	1711.	2335.	3052.	3864.
OUTFLOW=	0.	93.	776.	1934.	3410.	4800.	6737.	11864.	17569.	24118.

STATION 113, PLAN 1, RTIO 1

0.	0.	1.	7.	19.	39.	89.	476.	1030.	1699.
2321.	2805.	3069.	3058.	2795.	2429.	2085.	1786.	1531.	1312.

BY D.J.M DATE 4-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A17 OF

CHKD. BY DATE CUSHMAN LAKE DAM INSPECTION PROJECT C226

SUBJECT

1124.	963.	825.	715.	618.	531.	455.	390.	334.	286.
245.	210.	180.	154.	132.	113.	97.	90.	84.	78.
71.	63.	56.	50.	43.	35.	26.	19.	14.	11.
8.	6.	4.	3.	2.	2.	1.	1.	1.	1.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STOR

0.	0.	2.	11.	31.	65.	148.	294.	478.	676.
859.	1002.	1080.	1077.	999.	891.	789.	701.	626.	561.
506.	458.	417.	381.	346.	314.	287.	263.	243.	225.
210.	198.	187.	177.	169.	162.	156.	150.	141.	130.
118.	106.	94.	83.	72.	59.	44.	32.	24.	18.
13.	10.	7.	5.	4.	3.	2.	2.	1.	1.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	10-DAY	30-DAY	90-DAY	TOTAL VOLUME
CFS	3069.	861.	288.	231.	34595.
INCHES		11.52	11.58	11.58	11.58
AC-FT		17083.	17163.	17163.	17163.

STATION 113, PLAN 1, RTIO 2

0.	0.	1.	5.	15.	31.	71.	341.	796.	1357.
1856.	2244.	2455.	2446.	2236.	1943.	1668.	1429.	1225.	1049.
899.	771.	672.	578.	496.	425.	364.	312.	267.	229.
196.	168.	144.	124.	106.	92.	88.	82.	75.	67.
60.	54.	47.	41.	36.	29.	22.	16.	12.	9.
6.	5.	4.	3.	2.	1.	1.	1.	1.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STOR

0.	0.	2.	9.	25.	52.	118.	245.	409.	575.
722.	836.	899.	896.	834.	748.	666.	596.	535.	484.
439.	401.	365.	331.	301.	276.	253.	235.	218.	204.
193.	182.	174.	166.	160.	154.	146.	136.	124.	112.
101.	89.	79.	69.	60.	48.	36.	27.	20.	15.
11.	8.	6.	4.	3.	2.	2.	1.	1.	1.
1.	0.	0.	0.	0.	0.	0.	0.	0.	0.

BY D.J.M. DATE 4-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A18 OF

CHKD. BY ______ DATE ______ CUSHMAN LAKE DAM INSPECTION PROJECT C226

SUBJECT

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	10-DAY	30-DAY	90-DAY	TOTAL VOLUME
CFS	2455.	689.	231.	185.	27676.
INCHES		9.22	9.26	9.26	9.26
AC-FT		13664.	13731.	13731.	13731.

STATION 113, PLAN 1, RTIO 3

0.	0.	0.	3.	7.	16.	36.	86.	366.	641.
908.	1120.	1227.	1223.	1118.	972.	834.	721.	625.	537.
460.	394.	338.	290.	248.	213.	182.	156.	134.	115.
98.	90.	85.	78.	71.	64.	57.	51.	45.	39.
34.	30.	26.	22.	19.	15.	11.	8.	6.	5.
3.	3.	2.	1.	1.	1.	1.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STOR

0.	0.	1.	4.	12.	26.	59.	144.	254.	354.
442.	505.	536.	535.	504.	461.	420.	383.	348.	316.
288.	264.	244.	226.	211.	198.	187.	178.	170.	163.
157.	150.	141.	130.	119.	107.	95.	84.	74.	65.
57.	50.	43.	37.	32.	26.	19.	14.	10.	8.
6.	4.	3.	2.	2.	1.	1.	1.	1.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	10-DAY	30-DAY	90-DAY	TOTAL VOLUME
CFS	1227.	344.	115.	92.	13838.
INCHES		4.61	4.63	4.63	4.63
AC-FT		6830.	6865.	6865.	6865.

PEAK FLOW SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS

OPERATION	STATION	PLAN	RATIOS APPLIED TO FLOWS 0.50	0.40	0.20
HYDROGRAPH AT	13	1	3153.	2522.	1261.
		2	1234.	612.	0.
ROUTED TO	113	1	3069.	2455.	1227.
		2	1234.	612.	0.